

# Evaluation of Satellite-Derived Information as an Analysis Tool and to Improve Predictability Over Conventional Data-Sparse Regions

William L. Smith  
UW-CIMSS  
1225 West Dayton St.  
Madison, WI 53706  
608 264 5325  
608 262 5974  
[bill.l.smith@larc.nasa.gov](mailto:bill.l.smith@larc.nasa.gov)

Christopher S. Velden  
UW-CIMSS  
1225 West Dayton St.  
Madison, WI 53706  
608 262 9168  
608 262 5974  
[chrisv@ssec.wisc.edu](mailto:chrisv@ssec.wisc.edu)

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## LONG-TERM GOALS

The primary goal of this study was to develop and evaluate satellite-based meteorological products over mid-latitude domains. The meteorological targets of interest were centered on two field programs aimed at the analysis and forecasting of extratropical cyclones.

The goals were to demonstrate the product usefulness in objective analyses, as well as forecasting. Assimilation of the quantitative information into the objective analyses also was a component of the partner research program at NPS.

## OBJECTIVES

Develop prototype products from satellite-based sensors that yield atmospheric wind and advection information over data-void regions.

Demonstrate the real time derivation of these products, and use in field experiment mission planning and forecasting to simulate an operational setting.

Use the products in concert with other data sources to examine meteorological science issues.

Examine the impact of the satellite data in data assimilation systems, objective analyses and forecasting systems.

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## APPROACH

The satellite data and products were derived in real time during two prominent field programs, FASTEX and NORPEX. Both programs were aimed at determining the optimum mix of observations and data targeting strategies for providing initialized fields of developing extratropical cyclones. UW-CIMSS was responsible for the satellite data derivation and preparation. The datasets were then disseminated to the respective field experiment headquarter sites for real time evaluation in mission planning.

After the field phase, the datasets were evaluated for their impact on initial conditions through data impact experiments utilizing two Navy models (global and mesoscale). These tasks were carried out at NRL/MRY (Langland, Gelaro, Rohaly) and at NPS (Nuss and Miller).

## WORK COMPLETED

This annual report encompasses year two of the two-year proposed effort. In this year, datasets from both FASTEX and NORPEX were distributed to NRL and NPS for evaluation in NOGAPS and MQ-NORAPS, respectively. For FASTEX, the entire 6-week period was used to evaluate data impact in NOGAPS. For MQ-NORAPS, FASTEX case studies were identified and focussed on. For NORPEX, the entire 6 week period was evaluated using NOGAPS.

## RESULTS

The satellite-derived datasets were successfully employed in real time at the field experiment sites. The data were used in mission planning, to adjust targeted sampling (dropsondes), and to describe the initial conditions for subjective nowcasting and forecasting. In this regard, the objective of operational demonstration and usefulness was a resounding success.

The objective evaluation of the datasets through numerical experimentation and impact studies yielded interesting results. 5 FASTEX case study periods were examined using NOGAPS. In 4 of the cases, there was significant improvement in the forecast of the target cyclone features with the addition of the satellite data. The fifth case was neutral impact. In one case study examined to date using MQ-NORAPS, the forecast impact was minimal, however cyclone structure was altered. In regards to the NORPEX datasets, the impact on NOGAPS forecasts was significant. Mean forecast errors were lowered, and in many cases the positive impact was stronger than aircraft dropsonde data.

## IMPACT/IMPLICATIONS

FASTEX and NORPEX has implications on targeted observing strategies. The results of The positive evaluation of the satellite data impact on the NOGAPS forecasts during examining individual events during the field programs suggests the enhanced and advanced satellite datasets may alter, or even preclude the need for aircraft mission with dropsonde targeting. Under certain conditions, the enhanced satellite data may provide the necessary information to improve the forecasts. However, other cases are evident where the satellite data was insufficient, and further investigation will be necessary.

## **TRANSITIONS**

The results of this study have illustrated the potential of the advanced processing techniques to extract satellite information into meteorological quantities for assimilation into numerical analysis and forecast systems. Much was learned, and future directives will be aimed at transitioning these experimental techniques into Navy operations.

## **RELATED PROJECTS**

Similar satellite-derived product development and evaluation is ongoing in concert with NRL-MRY towards tropical applications. An ONR grant, administered through NRL-MRY, is supporting efforts to apply the satellite products to improve the analysis and forecasting of tropical cyclones. Results have also been encouraging with significant positive impact on NOGAPS forecasts, and positive input from the Joint Typhoon Warning Center on Guam.

## **PUBLICATIONS**

Gelaro, R., R.H. Langland, G.D. Rohaly, and T.E. Rosmond, 1998: An assessment of the singular vector approach to targeted observing using FASTEX data set. *Quart. J. Roy. Meteor. Soc.*, in press.

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Langland, R.H., Z. Toth, R. Gelaro, I. Szunyogh, S.J. Majumdar, R. Morss, G.D. Rohaly, C. Velden, N. Bond and C. Bishop, 1998: The North Pacific Experiment – 1998 (NORPEX-98): Targeted observations for improved North America weather forecasts. *Bull. Amer. Meteor. Soc.*, in review.

## **IN-HOUSE/OUT-OF-HOUSE RATIOS**

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